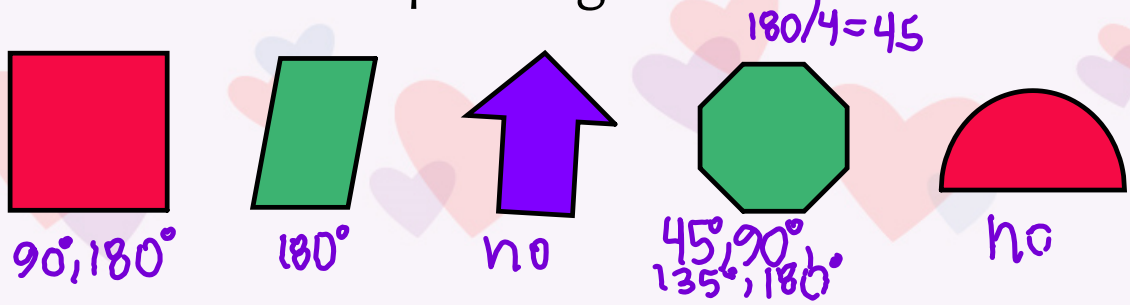
# 9.4 Rotations

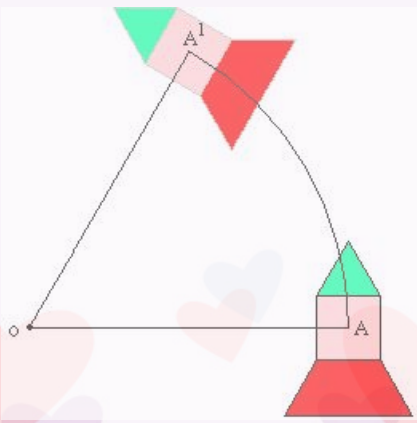
A figure in a plane has rotational symmetry if the figure can be mapped onto itself by a rotation of 180° or less.

Example 1

Which of the following figures have rotational symmetry? For those that do, describe the rotations that map the figure onto itself.

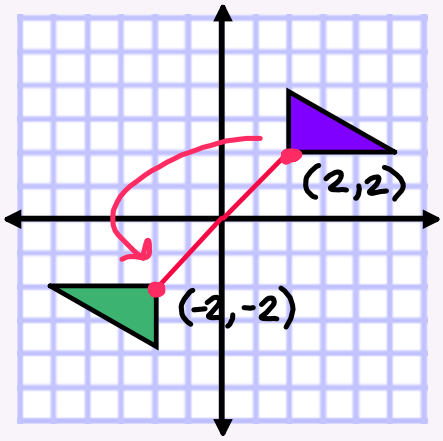


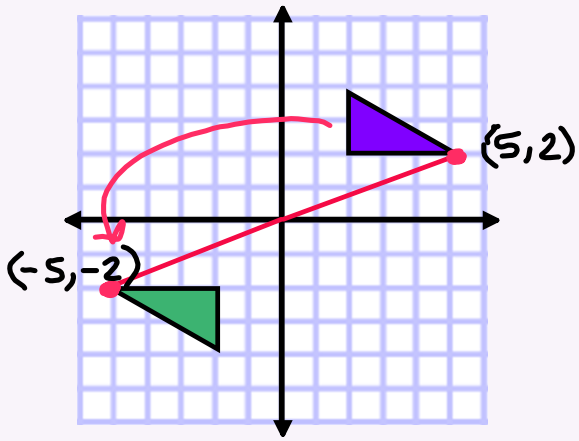

A rotation is a transformation in which a figure is turned about a fixed point. The fixed point is the center of rotation. Rays drawn from the center of rotation to a point and its image form an angle called the angle of rotation.




Theorem 7.2:
Rotation Theorem

A rotation is an isometry.

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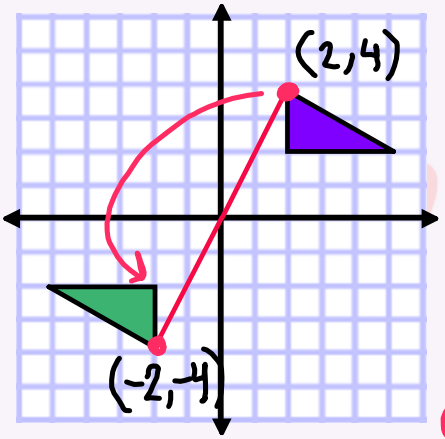
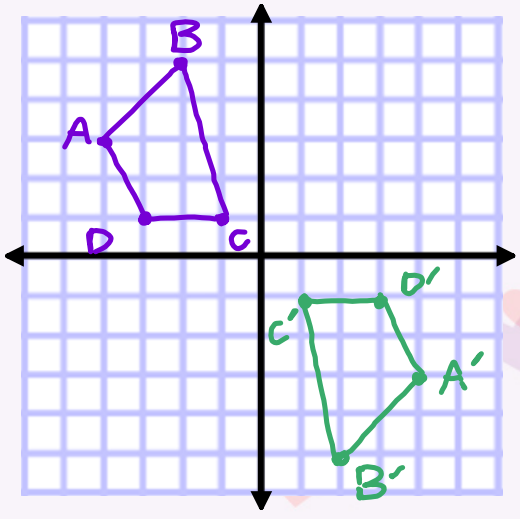


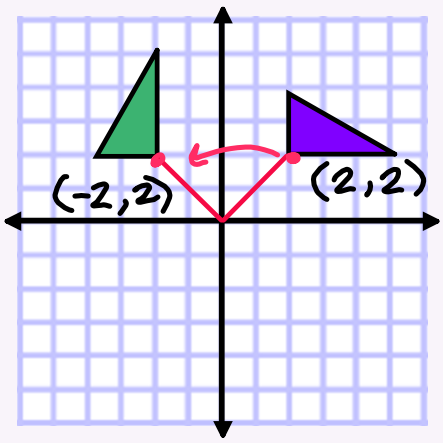

Rotation?
180°
Direction?
CW / CCW
Change in coordinates?
$(x,y) \rightarrow (-x,-y)$

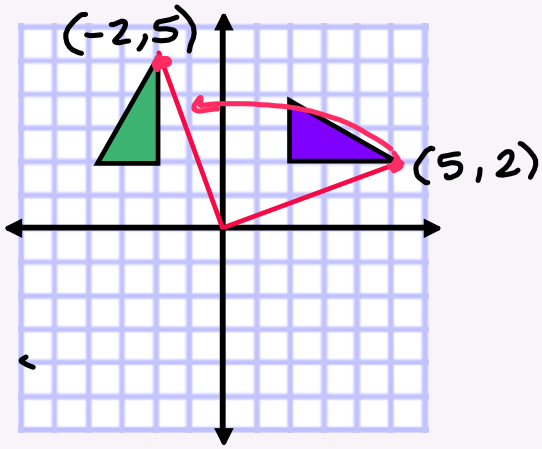
## Example 2

In a coordinate plane, sketch the quadrilateral whose vertices are A(-4,3), B(-2,5), C(-1,1), and D(-3,1). Then rotate ABCD 180° about the origin and name the coordinates of the new vertices.

A′(4,-3)
B′(2,-5)
C′(1,-1)
D′(3,-1)



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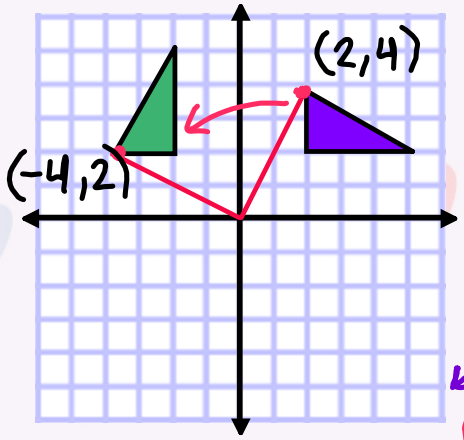
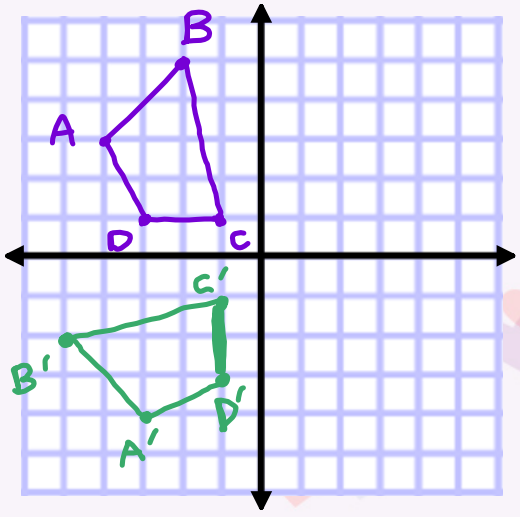


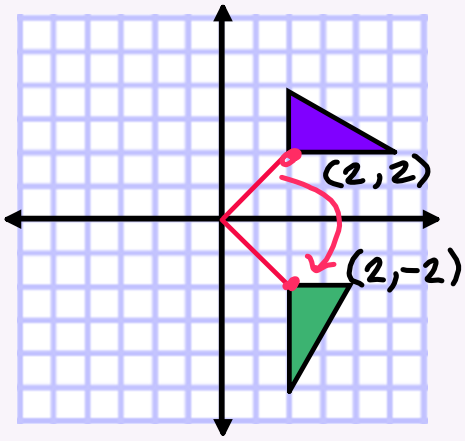

Rotation?
90°
Direction?
CCW
Change in coordinates?
$(x, y) \rightarrow (-y, x)$

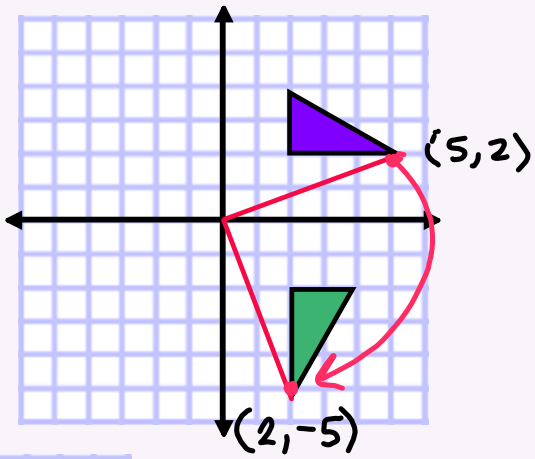
## Example 3

In a coordinate plane, sketch the quadrilateral whose vertices are A(-4,3), B(-2,5), C(-1,1), and D(-3,1). Then rotate ABCD 90° counterclockwise about the origin and name the coordinates of the new vertices.

$A(-4,3) \rightarrow A'(-3,-4)$
$B(-2,5) \rightarrow B'(-5,-2)$
$C(-1,1) \rightarrow C'(-1,-1)$
$D(-3,1) \rightarrow D'(-1,-3)$



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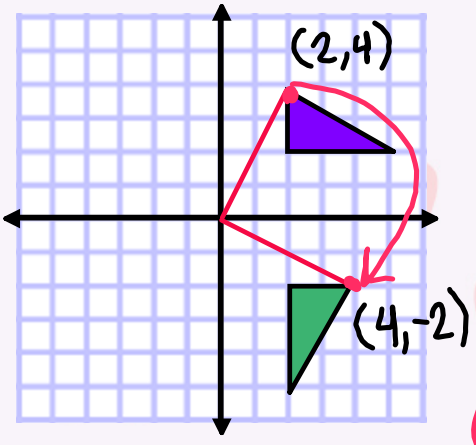
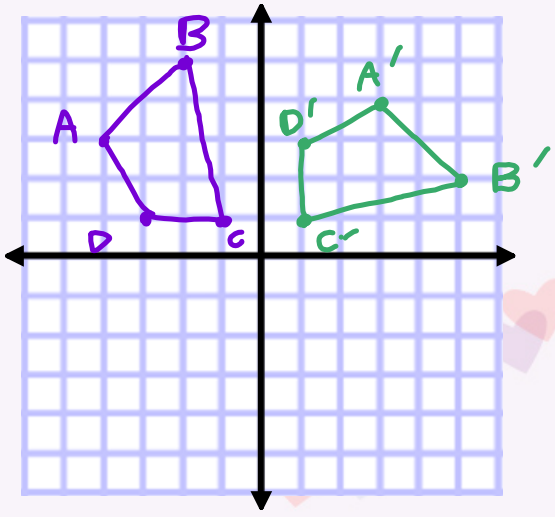



Rotation?
90°
Direction?
CW
Change in coordinates?
(x,y) → (y,-x)

## Example 4

In a coordinate plane, sketch the quadrilateral whose vertices are A(-4,3), B(-2,5), C(-1,1), and D(-3,1). Then rotate ABCD 90° clockwise about the origin and name the coordinates of the new vertices.

A(-4,3) → A'(3,4)
B(-2,5) → B'(5,2)
C(-1,1) → C'(1,1)
D'(-3,1) → D'(1,3)



## Example 5

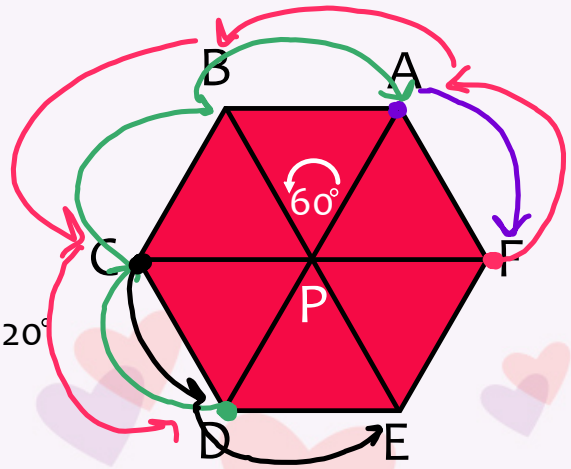
The diagonals of the regular hexagon below form six congruent triangles. Use the diagram to complete each sentence.

A) A clockwise rotation of 60° about P maps A onto F.
fixed point

B) A clockwise rotation of 180° about P maps D onto A.

C) A counterclockwise rotation of 120° about P maps C onto E.

D) A counterclockwise rotation of 240° about P maps F onto D.




## Example 6

State the segment or triangle that represents each image.

A) 90° clockwise rotation of $\overline{ED}$ about P
$\overline{CB}$

B) 90°clockwise rotation of $\overline{HJ}$ about P
$\overline{FK}$

C) 90° counterclockwise rotation of $\overline{GP}$ about P
$\overline{AP}$

D) 90° counterclockwise rotation of $\overline{BL}$ about P
$\overline{DK}$

E) 180° clockwise rotation of $\overline{HI}$ about P
$\overline{DK}$

F) 180° counterclockwise rotation of ΔFEK about P
ΔBAI